Kentucky Method 64-114-08
Revised 07~~2~~/24~~5~~/08
Supersedes 64-114-08~~3~~
Dated 02/~~11~~25/08~~3~~

CAMERA/VIDEO INSPECTION OF PIPE WITH ALTERNATE METHODS OF DEFLECTION MEASUREMENT

~~MEASUREMENT OF CULVERT PIPE DEFLECTION BY MANDREL TESTING, PIPE LINE CAMERA/VIDEO INSPECTION, OR PHYSICAL MEASUREMENTS~~

1. SCOPE: This method provides procedures for camera inspection of pipe and three methods of determining deflection: laser, mandrel testing, and physical measurements.

2. APPARATUS:

   2.1. Camera Inspection Equipment: Provide a pipeline inspection camera having the following features:

      1) Configured properly in the pipe both vertically and horizontally, and having the ability to pan and tilt to a 90 degree angle with the axis of the pipe and rotate 360 degrees.
      2) Low barrel distortion camera.
      3) Color image with a minimum standard resolution of 720 x 480 pixels.
      4) Equipped with sufficient lighting to provide a clear image of the full circumference of the pipe.
      5) Capable of recording the station, milepost, distance along the invert of the pipe, or other indicators of location superimposed on the video.
      6) Capable of moving through entire length of pipe.
      7) Capable of measuring cracks greater than 0.1” and joint separations greater than 0.5”.

   2.2. Laser deflection measuring device: For use on corrugated metal and HDPE pipe, provide a laser deflection measuring device capable of measuring deflection to an accuracy of 0.5% or better and a repeatability of 0.12% or better.

   2.3. Mandrel: Use a mandrel device with an odd number of legs (9 minimum) having a length not less than the nominal outside diameter of the mandrel. Ensure the diameter of the mandrel at any point is 5%, 7.5% or 10% less than the Measured Mean Interior Diameter (MMID) of the pipe being tested. Calibrate the mandrel’s diameter before and after each day’s inspection by use of true circular rings of diameters equal to 5%, 7.5% or 10% less than Measured Mean Interior Diameter (MMID) of the pipe being tested.

   2.4. Physical Measuring Tools: Use contact or non-contact distance instruments. This may include tape extensometers, standard folding wooden carpenters tape with a 6-inch slide or a standard retractable metal carpenters tape. The measuring device should be readable to the nearest 1/16-inch.

3. PROCEDURE:

   3.1. Ensure pipe is clear of debris or obstructions. Complete the video inspection and any necessary measurement prior to placing the final surface over any pipe. When paving will

not be delayed, take measurements 30 days or more after the completion of earthwork to within 1 foot of the finished subgrade. Notify the Engineer a minimum of 24 hours in advance of inspection. Notify the Engineer immediately if distresses or locations of improper installation are logged.

3.2. Pipeline Camera/Video Inspection:

3.2.1. Begin at the outlet end and proceed through to the inlet at a speed less than or equal to 30 ft/minute. Remove blockages that will prohibit a continuous operation.

3.2.2. Calibrate the laser deflection measuring device according the manufacturers specifications. Provide all calibration data and applicable manufacturers recommendations for calibration and use to the Resident Engineer.

3.2.3. Document locations of all observed defects and distresses including deflections, separations, improper joints or connections, blockages, leaks, rips, or deviation from line and grade. Capture still frame images from the video to accompany the location and description data.

3.2.4. Measure the deflection occurring at the point of the projected laser and at a minimum interval of 0.1 feet along the pipe.

3.2.5. Provide a continuous 360 degree pan of every pipe joint.

3.2.6. Identify and measure all cracks greater than 0.1” and joint separations greater than 0.5”.

3.3. Mandrel Testing: Mandrel testing will be used for deflection testing if the video measurements are called into question or if limitations in the laser deflection measuring device are exceeded. Physical measurements as described in Section 3.4 may also be used in lieu of the laser or mandrel methods.

3.3.1. Measured Mean Interior Diameter: Due to allowed fabrication tolerances, drainage pipes are manufactured with variances from the “nominal” diameter of the pipe. For this reason, it is required to estimate the actual mean interior diameter for the pipe run by direct measurements. This is required information for mandrel and direct measurements. To determine the Measured Mean Interior Diameter pick two sections in the pipe that show no deflection. Measure the diameter of the pipe along the horizontal and vertical directions. If these measurements vary by 1% or less, consider this section as having no deflection and record these two measurements. Repeat the procedure for the other section. Average these 4 measurements to arrive at the measured mean internal diameter.

3.3.2. Use a mandrel with its diameter set to 5%, 7.5% or 10% less than the Measured Mean Interior Diameter (ID) of the pipe being tested. Calibrate the mandrel’s diameter by a true circular ring prior to testing, and obtain the Engineer’s approval. Clear the invert of the pipe of any debris prior to testing. Pipes with paved inverts will likely require some mandrel modification.

3.3.3. Shoot, blow, or float a line through the culvert. Attach the tow line and a trailing line to the mandrel for testing. Depending on the mandrel, it may be necessary to keep tension on the trailing line to keep the mandrel from tipping. Pull the mandrel, from the outlet end through the test segment by hand. Do not apply excessive force in pulling the mandrel that may damage the pipe or that may erroneously indicate that deflection was within acceptable limits by temporarily expanding the pipe. The line shall be termed "acceptable" if, during final deflection testing, the mandrel passes completely through the line without restriction. If refusal is encountered on the mandrel set at 5% less than the MMID, then pull a mandrel measuring 7.5% less than the MMID through the pipe. If refusal is encountered on the 7.5% mandrel, then pull a mandrel measuring 10% less than the MMID through the pipe. If refusal is encountered pulling from the outlet end, then repeat the process pulling from the upstream end.

3.3.4. Record the testing information on the data sheet and submit it to the Engineer.

3.4. Physical Measurements: Alternate method for camera and deflection testing when there is available access.

3.4.1 Use a contact or non-contact distance instrument. A leveling device is recommended for establishing or verifying vertical and horizontal control.

3.4.2. Physical measurements may be taken after installation and compared to the Measured Mean Interior Diameter of the pipe. When this method is used, determine the smallest interior diameter of the pipe as measured through the center point of the pipe (D2). Take the D2 measurements at the most deflected portion of the pipe run in question and at intervals no greater than ten (10) feet through the run. Calculate the deflection as follows:

% Deflection = [(MMID - D2) / MMID] 100%

Note: The Engineer may require that preset monitoring points be established in the culvert prior to backfilling. For these points the pre-installation measured diameter (D1) is measured and recorded. Deflection may then be calculated from the following formula:

% Deflection = [(D1 – D2) /D1] (100%)

4. REPORT: Submit all recorded information to the Engineer on standard forms along with the complete video inspection on DVD in digital format. The forms used for reporting must be approved by the Engineer prior to beginning the inspection. Ensure all video pipe runs on the DVD have the station, milepost, distance into the drain or other indicators of location superimposed on the video. Submit two copies of the paper report and DVD and one electronic copy of the report. All reports contain the following information:

Date Tested:
Name/Signature of Tester:
Location Information
Contract ID No.:

Project No.:
Milepoint Description of Project:
District:
County:
Route:
Station:
Calibration results and time of calibration:

Culvert and Embankment Information

Pipe Usage (Cross Drain, Storm Drain, Entrance, etc)
Pipe Type and Size:
Any Lining, Coating or Paving Applied to the Pipe:
Culvert Length:
Backfill Type:
Completion Date of Culvert:
Embankment Completion Date:
Final Embankment Height:

Test Data

Location of all observed Deflections greater than 5%:
Location of all observed cracks greater than 0.1 inch:
Location of all observed Joint Separations greater than 0.5 inch:
Location, Dimension, and Severity any other critical Defects and Distresses:
Deflection Test Method used (Mandrel Laser, Physical):
Plot of Deflection along the pipe for each pipe run:
Maximum Observed Deflection:
Location:

~~1. SCOPE: This method provides three procedures for determining the percent of deflection in culvert pipes: mandrel testing, camera video inspection, and physical measurements.~~

~~2. APPARATUS:~~

~~2.1. Mandrel: Use a mandrel device that is cylindrical in shape having 9 possible contact points with the pipe.~~

~~2.2. Camera Testing Equipment: Use a pipe line video inspection camera, a laser light ring projector, frame grabber board and computer. Mount the light ring projector onto and in front of a pipe line video inspection camera.~~

~~2.3. Physical Measuring Tools: Use contact or non-contact distance instruments. This may include tape extensometers, standard folding wooden carpenters tape with a 6-inch slide or a standard retractable metal carpenters tape. The measuring device should be readable to the nearest 1/16-inch.~~

~~3.PROCEDURE:~~

~~3.1. Complete the inspection and measurement prior to paving over any pipe. When paving will not be delayed, take measurements 30 days or more after the backfill is completed.~~

~~3.2. Mandrel Testing:~~

3.2.1. Use a mandrel with its diameter set to 5% less than the nominal interior diameter (ID) of the pipe being tested. Calibrate the mandrel's diameter by a true circular ring prior to testing, and obtain the Engineer's approval. Clear the invert of the pipe of any debris prior to testing. Pipes with paved inverts will likely require some mandrel modification.

3.2.2. Shoot, blow, or float a line through the culvert. Attach the tow line and a trailing line to the mandrel for testing. Depending on the mandrel, it may be necessary to keep tension on the trailing line to keep the mandrel from tipping. Pull the mandrel, from the outlet end through the test segment by hand. Do not apply excessive force in pulling the mandrel that may damage the pipe or that may erroneously indicate that deflection was within acceptable limits by temporarily expanding the pipe. The line shall be termed "acceptable" if, during final deflection testing, the mandrel passes completely through the line without restriction. If refusal is encountered on the 5% mandrel, then pull a mandrel measuring 10% less than the nominal ID through the pipe. If refusal is encountered pulling from the outlet end, then repeat the process pulling from the upstream end.

3.2.3. Record the testing information on the data sheet and submit it to the Engineer.

3.2. Pipeline Camera/Video Inspection:

3.3.1. Project the light ring a set distance away from the camera so that the entire ring is in view by the trailing inspection camera. Measure deflection by using a computer and frame grabber card and software. Where deflection is evident, capture the image and use the software to measure the deflection occurring at the point of the projected laser ring.

3.3.2. Calibrate the projected light or laser ring at the start of the inspection. To calibrate a captured image an object of known length must be viewable and in the same plane as the laser ring or the pipe must be physically measured at one location where the ring is projected.

3.3.3. The Engineer will set the required intervals for the deflection measurements to be taken. If higher deflections are observed between the set intervals, then additional measurements shall be taken at these locations. Take the deflection measurements in the vertical (6 to 12 o'clock) and horizontal (9 to 3 o'clock) unless other deflection is noted by the video inspection. Some systems allow for continuous monitoring for deflection in which a preset deflection value such as 5% deflection can be preset into the program.

3.3.4. The benefit of this method is that not only deflection can be measured but also other defects can be noted. These may include vertical and horizontal joint offsets, cracking, spalling, rusting, debris, etc. Include this information with the inspection data sheet and submit to the Engineer along with the video tape.

3.3. Physical Measurements:

~~3.4.1. Use a contact or non-contact distance instrument. A leveling device is recommended for establishing or verifying vertical and horizontal control.~~

~~3.4.2. Physical measurements may be taken (D2) and compared to nominal ID of the pipe after installation. When this method is used, ensure that the measurements are taken through the center point of the pipe. Calculate the deflection as follows:~~

~~% Deflection = [(Nominal ID – D2) / Nominal ID] 100%~~

~~Note: The Engineer may require that preset monitoring points (D1) be established in the culvert prior to backfilling. The ID of the culvert may then be monitored during the backfill process and after completion of the backfill (D2). Deflection may then be calculated from the following formula:~~

~~% Deflection = [(D1 – D2) /D1] (100%)~~

~~4. REPORT: Report deflection results to the nearest 0.1 percent on the data sheet.~~

APPROVED

DIRECTOR
DIVISION OF MATERIALS

DATE ~~02~~07/2~~45~~/08

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~~Attachment~~

km11408.doc

PIPE LINE DEFLECTION DATA SHEET

Date Tested:

Location Information

District:
County:
Route:
Project No.:
Station:

Culvert and Embankment Information

Pipe Usage (Cross Drain, Storm Drain, Entrance, etc)
Pipe Type and Size:
Culvert Length:
Backfill Type:
Completion Date of Culvert:
Embankment Completion Date:
Final Embankment Height:

Test Data

Deflection Test Method (Mandrel, Camera, Physical):
Maximum Observed Deflection:
Location: